# A Risk Assessment and Analysis Process

Leading Community Risk Reduction

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*Appendix A Not Included. Please visit the Learning Resource Center on the Web at http://www.lrc.dhs.gov/ to learn how to obtain this report in its entirety through Interlibrary Loan.*

## ABSTRACT

Largo Fire Rescue has responded annually to fires, EMS responses, Hazmat, tropical storms and hurricanes that impact the fire response area. In the past, the process for assessing risk of occupancies has not been an organized, objective process.

The problem was that Largo Fire Rescue had not performed a risk assessment and evaluation to validate emergency response coverage. Without this assessment, decisions were made that may not have provided the most effective deployment of resources to assist in the mitigation of an incident.

The purpose of this action research was to perform a risk assessment and analysis to assist Largo Fire Rescue to validate or amend current emergency response coverage. An evaluation of previously assigned "risk levels" of occupancies in Largo determined if current responses were adequate for the identified risks. To do this, the action research answered three questions:

1. What needs to be considered in performing a risk assessment and analysis for Largo Fire Rescue?
2. How can fire risk data assist in a risk reduction assessment and analysis to validate emergency response coverage?
3. How can a risk assessment and analysis assist Largo Fire Rescue in validating the existing emergency response coverage?

After research and several intradepartmental meetings, it was decided that an objective scoring system utilizing a quantitative scale of measurement was the best method to perform this task. A document was created which outlined this standardized assessment procedure and was used to validate existing fire response coverage.

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## INTRODUCTION

In order to produce effective plans in anticipation of an emergency event, an analysis of the potential risks to the community is essential in determining where resources should be allocated to be adequately prepared. Risk assessment will answer the questions: What are the risks inherent to the community served? How quickly can resources be deployed to mitigate an identified risk? How quickly will those resources be needed? Armed with this specific information as to the potential extent, scope, depth and severity of the risk to the community, fire service leaders can make informed decisions leading to an effective and efficient effort to respond to identified risks prior to the event occurring.

The problem is that Largo Fire Rescue has not performed a risk assessment and evaluation to validate emergency response coverage. Without this assessment, decisions are made that may not provide the most effective deployment of resources to assist in the mitigation of an incident.

Largo is prepared for the annual onslaught of tropical storms and hurricanes that threaten the gulf coast. Specific and detailed plans exist and are implemented on a regular basis due to the recurring nature of these threats. However, a specific assessment of the risks facing our community has never been accomplished. In addition, Largo Fire Rescue has focused more specifically on tropical events and has largely discounted other risks as threats to the community. A successful risk assessment process should be an "all hazards evaluation."

The purpose of this action research was to perform a risk assessment and analysis to assist Largo Fire Rescue to validate current emergency response coverage. An

evaluation of previously assigned “risk levels” of occupancies in Largo determined if current responses were adequate for the identified risks. Risk assessment tools currently available from national resources, as well as locally prepared assessment tools were employed to assist in determining risk levels. The analysis answered the following questions:

1. What needs to be considered in performing a risk assessment and analysis for Largo Fire Rescue?
2. How can fire risk data assist in a risk reduction assessment and analysis to validate emergency response coverage?
3. How can a risk assessment and analysis assist Largo Fire Rescue in validating the existing emergency response coverage?

## Background and Significance

The fire service in general is well practiced in the art and science of “size up.” This term refers to the initial report of the first arriving unit on the scene of an emergency response. A size up reports to all incoming units and the responding incident commander the size and scope of the incident. This initial report provides the incident commander with information with which he or she can make strategic decisions about deployment and utilization of the balance of the responding units and the potential risk involved as well as the possible need for additional resources. The United States Fire Administration (1996) addresses this topic: Risk is defined as “ the possibility of meeting danger or suffering harm or loss” (p.4). Risk can be determined by the “probability that an undesired event might occur” (FEMA, 1996, p.4).

Largo Fire Rescue has historically been a progressive fire department. The organization has been an early adopter of technologies and processes that improve

organizational and operational efficiency and effectiveness. Benchmarking fire ground performance, adopting ALS engines in the early 1980's, and attaining CFAI accreditation, have been the hallmark of Largo Fire Rescue's historical approach to innovative and cost effective emergency response.

As an organization, Largo Fire Rescue has been successful in managing multiple missions. Fire suppression, emergency medical services, hazardous materials responses, technical rescue, tactical medics, heavy rescue, and extrication, are among the most common responsibilities shouldered by the men and women of Largo Fire Rescue. The missing link is an organized and comprehensive risk assessment of likely damage to be sustained by the community.

"Fire risk analysis is an essential step in determining a level of resources appropriate for a particular community. This risk analysis should be conducted systematically throughout the service area to determine an appropriate level of fire suppression resources that will provide adequate public protection. (Routley, 1991, p. 9-59).

Largo Fire Rescue had already conducted a comprehensive self-assessment in order to apply for and be granted accreditation by the Commission on Fire Accreditation international (CFAI). A risk assessment is a vital component of this self-assessment. During the application and review process the leadership of Largo Fire Rescue decided to review and update the risk assessment to determine if the original assessment provided the most accurate representation of risk in our community.

Most references to this topic discuss the planning phase of risk assessment as a basic step in fire protection management. Texts on the subject of planning agree that

planning is one of the major management functions. In fact planning is usually listed among the first management functions. Burns states that to adequately meet the demands of the community the fire service must "identify the nature and extent of the risks it faces" (p. 77).

The National Fire Academy Course "Leading Community Risk Reduction" stresses the coordinated and comprehensive identification of risks in a community in order to effectively deal with incidents that may occur. An effective risk assessment process can provide valuable information to those individuals tasked with resource allocation. Good decisions are only as good as the information on which they are based. Risk assessment provides that base for sound decision making.

By providing a specific and organized approach to the process of assessing the risks facing a community, fire service executives and political leaders can chart a course to respond with the specific knowledge needed to make decisions that will allocate resources with the greatest effectiveness.

## Literature Review

The literature review used to prepare this research included published Applied Research Projects of the Executive Fire Officer Program, journal articles, periodicals, and books obtained from either the National Fire Academy Learning Resource Center or the City of Largo Public Library.

"Fire risk analysis is a systematic means of analyzing the fire risk of a community and its protection capabilities through a detailed risk analysis methodology. Fire risk is defined as the potential vulnerability to fire with the possibility of loss, injury,

disadvantage or destruction" (Academy, 1984). The fire risk analysis is an evaluative tool, which can be used to weigh the risk to a community against the resources available.

This concept is the foundation of the premise that a response to an emergency can only be as effective as the understanding of the scope and size of the risks facing the community prior to an event. "Identifying risk exposure is the foundation of an integrated process for managing risks" (FEMA, 1996, p. 34).

A precursor to risk management is universally agreed upon. That is the function of planning and assessment. The purpose is to identify the kinds of things that create a risk to the community. "Whenever a community-rural, suburban or urban-considers its fire defenses, it must scrutinize the past and present and make predictions or forecasts for the future. The process of forecasting future conditions and preparing for them requires that a *planning* process be followed" (Peterson, 1991, p. 10-46). A thorough risk assessment provides the structure for a coordinated and appropriate level of response to any given risk situation.

According the Fire Chief's Handbook "Risk analysis is a systems approach that evaluates the following:

1. The community fire and emergency service system
2. The community at risk
3. The response capability
4. The unprotected risk
5. The strategies to consider (Barr & Eversole, 2003, p. 1026).

To adequately meet the demands of the community the fire department must "identify the nature and extent of the risks it faces" (Coleman, 1988, p. 77). This statement speaks

to the point that not only must a fire department identify the risks the probability of that hazard's likeliness to occur must be considered. Hazards that are very unlikely to occur pose a reduced risk threat to a community. "Knowing the types of emergencies likely to occur in one's locale, the probability of their happening and the magnitude of the potential problems are essential ingredients of emergency planning" ( Kramer & Bahme, 1992, p. 19).

The risk assessment itself is comprised of several components as demonstrated by the following graphic:

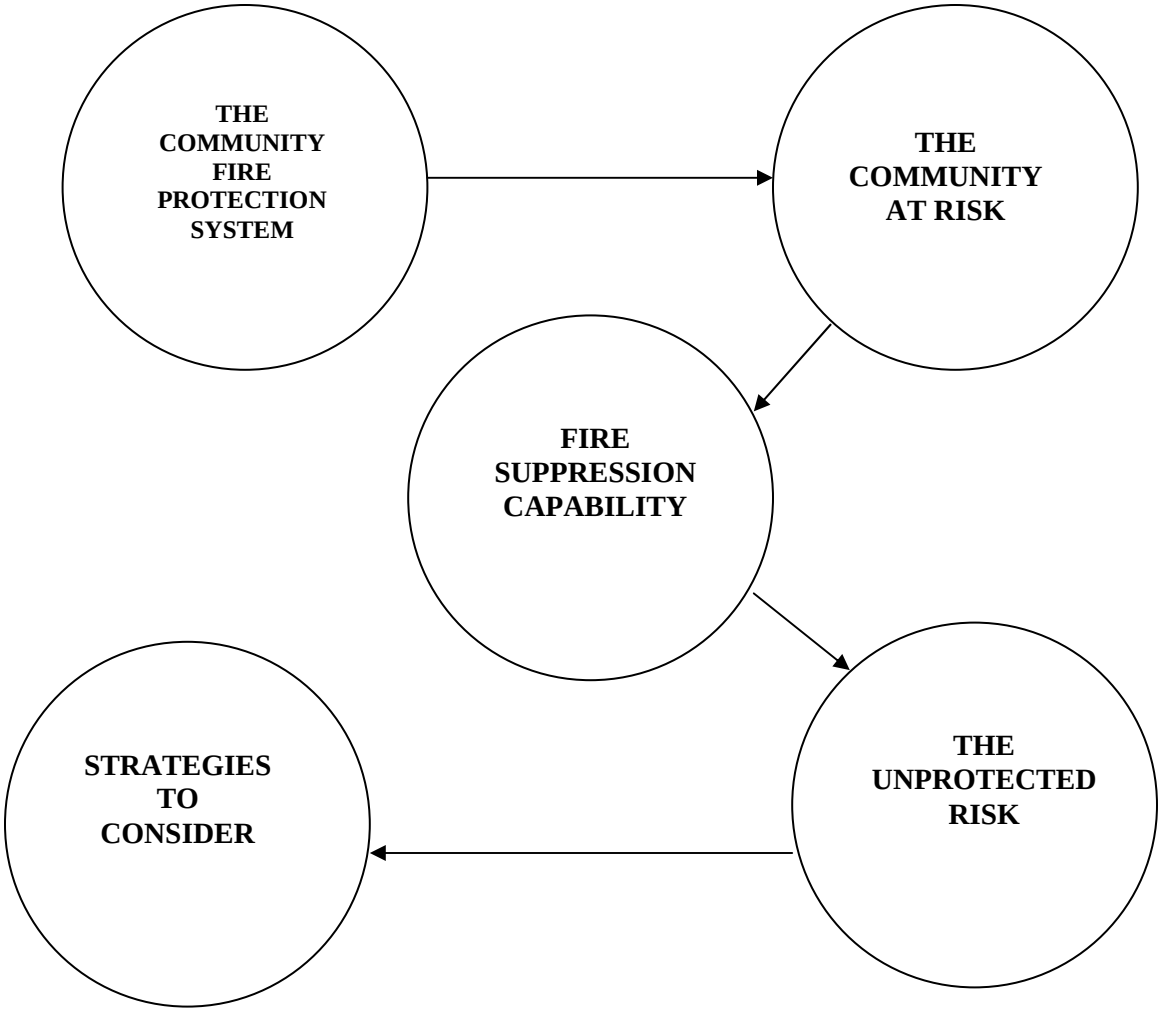


Figure 1. *Fire risk analysis-a systems approach* (Barr & Eversole, 2003, p. 1027).

The above figure is a visual representation of the process of conducting a risk assessment as recommended by the Fire Chief's Handbook. The intention of this graphic is to illustrate the step-by-step organized approach to a risk assessment process. Knowledge of risk versus capabilities leads the executive office to consider strategies to best mitigate that particular risk. This kind of approach provides for a methodical process with the best chance for an organized response.

The Commission on Fire Accreditation International also recommends that an integral part of the Standards of Cover process include a risk assessment. The assessment chart as recommended by this body divides risk into four distinct categories: "low probability, low consequences; low probability, high consequences; high probability low consequences; high probability, high consequences" (p.6).

Thus the process of risk assessment begins with careful planning followed by an identification of hazards, with a consideration of the likelihood of occurrence and the magnitude of the event should the identified hazard present itself. The final phase is a detailed appraisal of the fire departments capabilities to handle such events, and should be considered an important an integral portion of risk management. All phases require a careful, standardized approach to ensure appropriate responses, funding, and assistance is made available to the community.

## Procedures

The procedures in this action research project included a literature search and a review of risk assessment process from governmental sources, internet searches, trade journals and textbooks. Meetings by all divisions within the fire department including fire operations,

logistics and the fire marshal's office to discuss options followed this research. The planning group arrived at a consensus, which resulted in a written document.

A review of the available literature revealed descriptions of risk, risk management, and risk assessment methodologies. The method that most appealed to Largo Fire Rescue was described by Donner in 1997 (p.100). The program described a process of fire suppression companies performing fire inspections and assigning a life safety hazard value for every business. The calculation then allowed the department to prioritize responses to the particular hazard based on an objective scoring system. In Boulder, Colorado the values assigned to occupancies determined frequency of re-inspection. Businesses with a value of greater than 150 are inspected every year. For Largo Fire Rescue's purpose the values were used to determine risk for response purposes.

Largo Fire Rescue's fire response area is twenty-six square miles. The department has divided the fire response district into a grid system. Each grid is a one square mile by one-half mile area. Fire Inspectors are assigned to a specific number of grids within predefined sectors. Each inspector was provided a risk assessment form and performed a survey of business occupancies in their assigned inspection territory. These values were then data entered into a commercial software package. Data analysis was performed to determine which occupancies had the highest values and the location of these specific occupancies.

For the purposes of Largo Fire Rescue these values were used to determine which business occupancies required a fire suppression response greater than the minimum alarm sent to all standard structure fires. These types of occupancies were designated

“H” occupancies for “high hazard”. Once identified, the computer aided dispatch system was updated to reflect a higher level of response to those occupancies designated as high-risk facilities.

The response for these higher hazard occupancies received an additional engine to provide additional staffing, water flow, hose lines or other suppression support functions.

## RESULTS

For the purposes of this action research a document has been prepared which describes the recommended response for medical calls, fire calls, and high hazard calls. Specific and separate responses are already designed for landing zones, hazmat, technical rescue and other specialty responses. The attached document references structural fire responses in high hazard business occupancies.

This research has specifically answered for Largo Fire Rescue, the questions posed at the beginning of the research paper. It has identified components that need to be considered in performing a risk analysis, defined how fire risk data can assist in a risk reduction assessment, and provided validation that an altered and augmented response to high hazard occupancies is warranted and prudent.

Appendix A describes the risk analysis and the current responses as well as the augmented responses for occupancies meeting the predefined criteria as defined by the executive staff of Largo Fire Rescue.

Question 1 - What needs to be considered in performing a risk assessment and analysis for Largo Fire Rescue?

There appeared to be a generally agreed upon understanding of the components of a risk assessment process. The component that was commonly identified as the most

important was the identification of potential loss prior to an event. Wilder (1997) states that the first step is to "identify of potential loss in advance and act accordingly" (p.23). The ability to identify risks provides for effective planning and response. Preparation prior to an incident can determine the most effective manner to accomplish rapid mitigation.

Familiarity with the potential fire problem in a fire department's service area is needed in planning a response. This information is also important for a fire officer who is called upon to make rapid decisions affecting the deployment of apparatus and personnel at a fire scene.

In addition to planning there are other components that need to be considered in performing a risk assessment. Some other essential components that need to be considered to make a comprehensive analysis include:

- Life risk

  How many occupants are present? Does the building provide an alarm system? Are there adequate exits? Are the occupants ambulatory or dependant on the fire department to be found and rescued?

- Contents

  What is the fire load of the occupancy? Are the contents highly flammable? Are the contents valuable or prone to damage by water, smoke, and or heat?

- Construction

  Is the construction fire-resistant and likely to maintain structural integrity? Is the structure designed to inhibit flame spread and extension? Is the building compartmented with firewalls and doors?

- Built-in protection

  Is there an automatic alarm and suppression system in place?

- Time

  Is the occupancy one that would have sleeping occupants? If so is there an early detection and alarm system in place?

- Suppression resources

  Are the available fire suppression resources available and sufficient?

As Routley states “Assessment of fire hazards, together with a technical knowledge of fire, provides an understanding of the risk potential that can take some of the uncertainty out of fire suppression activities and fireground decision-making” (p. 9-59).

Question 2- How can fire risk data assist in a risk reduction assessment and analysis to validate emergency response coverage?

Fire risk data can assist in risk reduction by defining in the risk assessment process, what community assets are at in risk. This is a critical component and is based on the community’s building stock. What types of construction are present in the community? What are the hazards to life that exist in these occupancies? The risk assessment document used by Largo Fire Rescue clearly defines the type of risks present in each community and places a quantitative value on each of the occupancies. This objective, quantitative evaluation provides support for analysis and decision making based on actual risk. Thus reduction of risk to the community is primarily accomplished by planning, identification of risks, and planned responses to mitigate those identified risks. The data provides the essential building blocks for this process.

Largo Fire Rescue’s data collection document takes into account not only the

occupant load, building height, time of occupancy, and built-in protection systems such as sprinkler systems. These data points all have a significant impact on the risk assessment and the reconfigured risk reduction systems in place prior to an event occurring. Barr and Eversole when discussing the community at risk enumerate these same data points. “What is the occupancy type? Are there sprinklers or other fire protection systems? Is there an early warning system? What is the occupant load?” (p. 1028). These same considerations are included in the data collection tool designed to provide a risk reduction strategy through a risk analysis process.

“The objective of all risk assessment techniques is to reduce the truly serious loss in the community” (International, 1997, p.7). Risk data can provide executive fire officers with information needed to create initial fire suppression responses that are adequate to handle the initial report of fire from occupancies. The data collected through whatever method used provides the foundation for decision making which will determine what strategies will be employed and what tactics will be used to attain the goals and objectives determined to be the priorities for that incident. Having the foreknowledge of the level of occupancy, time of occupancy, occupant impairment potential, fuel load and building suppression and detection systems can allow for decisions to be made in an orderly, calm and informed setting. This contrasts with a company officer that must make split-second decisions when information is scarce and occupants are unable to provide valid, accurate information.

Fire risk data can allow for risk to be classified into specific defined categories. “The term risk category refers to assigning risks quantitative or qualitative value and then placing them in one of several predefined categories” (Tauber, 2000, p. 3).

Question 3- How can a risk assessment and analysis assist Largo Fire Rescue in validating the existing emergency response coverage?

One of the questions that weigh most heavily on a fire chief is that of sufficient resources. Does the community have the necessary resources to meet the challenges of the potential incidents that may face the fire department? In order to determine the answer to this question fire risk data must be analyzed, and responses to the risks determined.

In Largo, the current standard response for a structure fire consists of two engines staffed with three personnel each, one truck company with two personnel, one rescue vehicle with two personnel, one squad with two personnel, and a district chief as a command officer. This places a total of 13 firefighters on the fireground of a typical residential or commercial fire response.

Having identified those occupancies that are at greater risk using an objective, quantitative appraisal, it was clear that this response was inadequate for the occupancies determined to be a greater hazard to life, property or the community. It was determined after the analysis of the data that the majority of our risks fell into specific categories. The categories were determined to be high rises, hydrant deficient areas and hospitals / nursing facilities. The common thread for all of these identified risks was the letter H. Largo Fire Rescue labeled the responses to these occupancies “H” responses. As such, it was determined to add a third engine to these specific responses to augment the staffing, and fire ground capabilities bring the total fire ground command and staff to 16 firefighters. This additional engine company provided the ability to assign evacuation,

rapid intervention, a second attack group, search and rescue, water supply or any other assignment deemed critical by the incident commander.

It was clear after the analysis, that Largo Fire Rescue had deficiencies in response and coverage for specific occupancies in the fire district. This research and analysis resulted in identification of specific hazards to the lives of our citizens and the community of Largo in general that needed to be addressed.

A risk assessment and analysis assisted Largo Fire Rescue in validating the existing emergency response coverage by identifying specific occupancies where response was inadequate to meet the fire ground needs of that occupancy. A thorough analysis of the occupancies on the district and an assessment of that data provided Largo Fire Rescue executive staff with the information required to make critical response decisions as they related to the highest risk occupancies in the community.

## DISCUSSION

During the course of this research it became increasingly clear that the process of assessing risk in the community, is, in many cases, more important than the resources allocated to mitigate the incident. The risk analysis process allowed the staff to determine a plan of action to identify the hazards in the community using an objective, quantitative tool. As Mulligan (2001) indicated, the process is on-going and includes risk assessment both prior to and after large incidents. Although the action research document is primarily a “pre-incident” plan, the heightened awareness for post incident analysis is now continuously at the forefront of Largo Fire Rescue’s executive staff’s thought process.

Hawkins and McClees (1988) and Collins (2002) both stress the importance of planning and having an accurate assessment of risk and capabilities to deal with those potential risks. More importantly, life-safety and property preservation is a key component to the risk assessment and analysis process. Silbey (1994) indicated that this priority should be the highest among the multiple priorities facing any organization.

Largo Fire Rescue's new risk assessment and analysis process was developed using what many authors have termed cross functional or multi-discipline teams. This approach provided insights to the process that may have been missed if developed solely by the fire prevention division or by suppression / operations division.

Assessment and analysis of new occupancies has become a significant part of a proactive risk analysis process in Largo Fire Rescue. What used to be a disorganized approach to finding potential risk and life hazard has become a well-defined, organized, objective, and quantitative approach to risk analysis and response coverage determination.

The new risk assessment and analysis process for Largo Fire Rescue provides a standardized and clearly defined risk analysis process. The use of cross functional teams have allowed for life safety concerns by fire prevention specialists and fire ground operational response concerns to be combined for an effective analysis of the data and a rational and measured response. The augmented responses for the H occupancies were created for those occupancies at highest risk for life safety and fire ground operational concerns.

The risk analysis document created by Donner has resulted in an objective approach to risk assessment that can be applied to any occupancy size or type. The

process described in this paper has resulted in a efficient and effective method for assessing risk to the community and analyzing the response and coverage provided by the fire department in response to those risks. This process also provides for an immediate assessment of the life safety hazards that may exist as a result of a major weather or environmental event as well. The literature reviewed supported the need for this type of rapid, accurate assessment and easily fits into the tropical weather risks faced by Largo Fire Rescue each year.

The addition of this process to the department's risk assessment planning provides heretofore-unexplored area for risk assessment and response validation for our city. The ability to utilize an objective, quantitative tool to acquire information will assist in decision making for the executive staff of Largo Fire Rescue. This is a concept that will yield an effective method for providing appropriate responses of equipment and personnel to the scene of a fire to provide both mitigation and support to the citizens of the community served by Largo Fire Rescue.

## RECOMMENDATIONS

The research contained in this document lead to several recommendations for developing and implementing a risk analysis and assessment to validate existing emergency response coverage. First and foremost was the inclusion of multiple disciplines when initially developing a plan. This is vitally important if one is to gain a global picture of risk assessment and response coverage.

Secondly, is the use of an objective tool that uses quantitative criteria to determine the level of risk of each occupancy, this allows for comparative analysis of structures, and is essential in validating response coverage.

Thirdly an organized approach to data collection, analysis and response determination is a vital component. The appropriate responses all fit into categories not previously identified. This allowed for the computerized dispatch to predetermine the additional resources required above and beyond that of a normal response to a structure fire.

Largo Fire Rescue has created a process for risk analysis and assessment. The next phase will be to reevaluate those occupancies on an annual or bi-annual basis to see if changes have occurred that would require the modification of responses to these structures. The implementation of a citywide risk assessment is crucial to risk reduction in the community. This process provides for the assessment of the capabilities of the fire department, the composition of the community it serves and the risks facing the department. Periodic review and updating will provide a clear vision of the risks and allow for analysis of responses to those identified risks.

Readers of this applied research paper should consider adopting an objective quantitative risk analysis process. The assessment that follows should provide an organized approach to determine the validity of current responses as well as justification for response modification if required.

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